7E4063

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B. Tech. VII Semester (Main/Back) Examination, Nov-Dec-2011

Mechanical Engineering

7ME4 Steam Turbines and Steam Power Plant

Time : 3 Hours **Maximum Marks : 80**

Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five** questions selecting **one** question from **each unit**. All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.*

Unit - I

1. a) Draw a combined velocity triangle for impulse type turbine showing the effect of outlet whirl component. i.e. C_{w_2} is positive, C_{w_2} is negative and C_{w_2} is zero.

   b) A simple impulse steam turbine has one ring of moving blades running at 150m/s. The absolute velocity of steam at the exit from the stage is 85 m/s at an angle 80° from the tangential direction. Blade velocity coefficient is 0.82 and the rate of steam flowing the stage is 2.5 kg/s.
   If the blades are equiangular, determine.

   i) blade angles,

   ii) nozzle angle,

   iii) absolute velocity of steam issuing from the nozzle,

   iv) axial thrust,

   v) Power developed and

   vi) If the velocity of steam reaching nozzle as 90 m/s and nozzle coefficient 0.85 find the enthalpy drop in the nozzle. **(4+12)**

OR

1. a) Draw neat sketches of

   i) Pressure compounded (Rateau) impulse turbine

   ii) Velocity compounded(curtis) impulse turbine

   b) In a single stage impulse turbine the nozzle discharge the fluid on to the blades at an angle of 25° to the plane of rotation and the fluid leaves the blades with an absolute velocity of 300m/s at an angle of 120° to the direction of motion of the blades. If the blades have equal inlet and outlet angles and there is no axial thrust, estimate the blade angle, power developed per kg/s of fluid. **(6+10)**

Unit - II

2. a) Prove maximum diagram efficiency formula for reaction turbine.

   b) The velocity of steam leaving the nozzle of an impulse turbine is 900 m/s and the nozzle angle is 20°. The blade velocity is 300 m/s and the blade velocity coefficient is 0.7. Calculate diagram efficiency. **(8+8)**

OR

2. a) Describe briefly internal and external energy losses in steam turbines.

   b) At a particular ring of a reaction turbine, the blade speed is 67m/s,and the flow of steam is 4.54 kg/s, dry saturated at 1.4 bar. Both fixed and moving blades have inlet and exit angles of 35° and 20° resp. Determine, the heat drop required if steam expands with an efficiency of 80% **(8+8)**

Unit - III

3. a) How do open feed water heaters differ from closed feed water heater?

   b) Under what conditions does reheating increases the efficiency of the ideal Rankine cycle?

   c) Steam at 100 bar , 600°C enters the first stage turbine of an ideal Rankine cycle with reheat. The steam leaving the reheat section of the steam generator is at 500°C, and the condenser pressure is 0.06 bar. If the quality at the exit of the second stage turbine is 90%, determine the cycle thermal efficiency. **(3+3+10)**

OR

3. A power plant operate on a regenerative vapour power cycle with one closed feed water heater. Steam enters the first turbine stage at 120 bar, 520°C and expands to 10 bar, where some of the steam extracted and diverted to a closed feed water heater. Condensate leaving the feed water heater as saturated liquid at 10 bar passes through a trap into the condenser. The feed water leaves the heater at 120 bar with temperature of 170°C. The condenser pressure is 0.06 bar. Determine for the cycle.